Guide to the

FORTY-SECOND ANNUAL FIELD CONFERENCE

of the

SECTION OF GEOLOGY

of the

OHIO ACADEMY OF SCIENCE

APRIL 22, 1967

SILURIAN GEOLOGY OF WESTERN OHIO

EXECUTIVE VICE-PRESIDENT
OF SECTION C

ROBERT L. BATES
Ohio State University

GUIDE BOOK PREPARATORS

ALLAN L. HORVATH
University of Dayton

DALE SPARLING
University of Dayton

CONTRIBUTORS

GREGG KLOSTERMAN
American Aggregates

BOB ALBERTS
American Aggregates

And Others

UNIVERSITY OF DAYTON

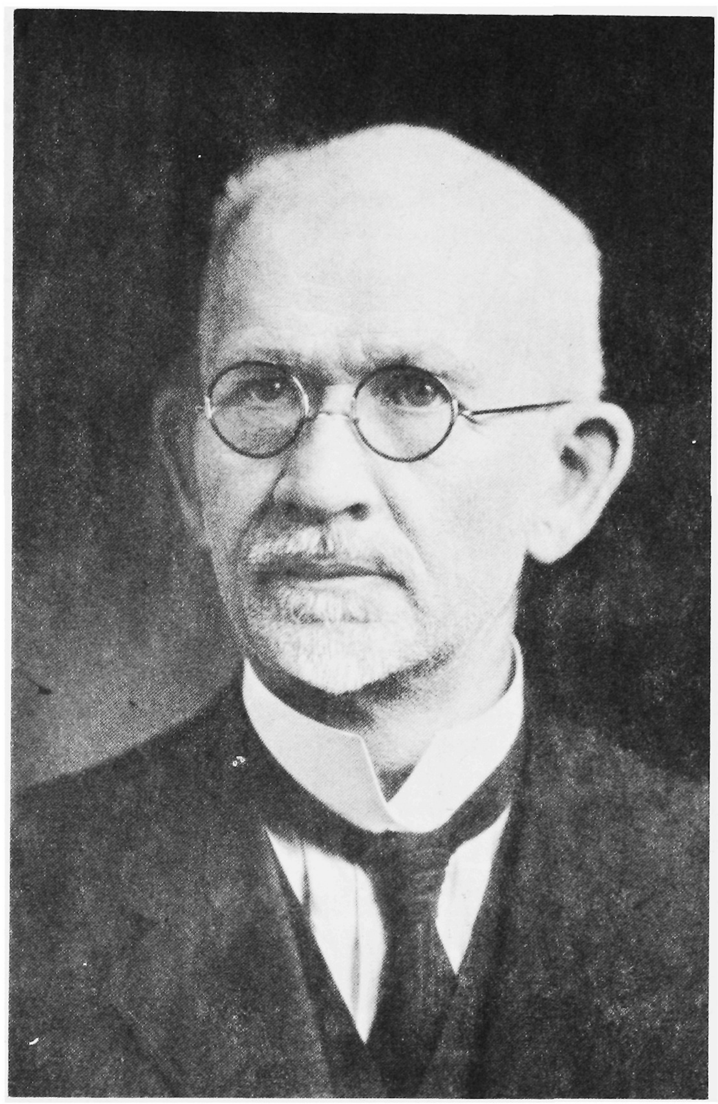
1967

DEDICATION

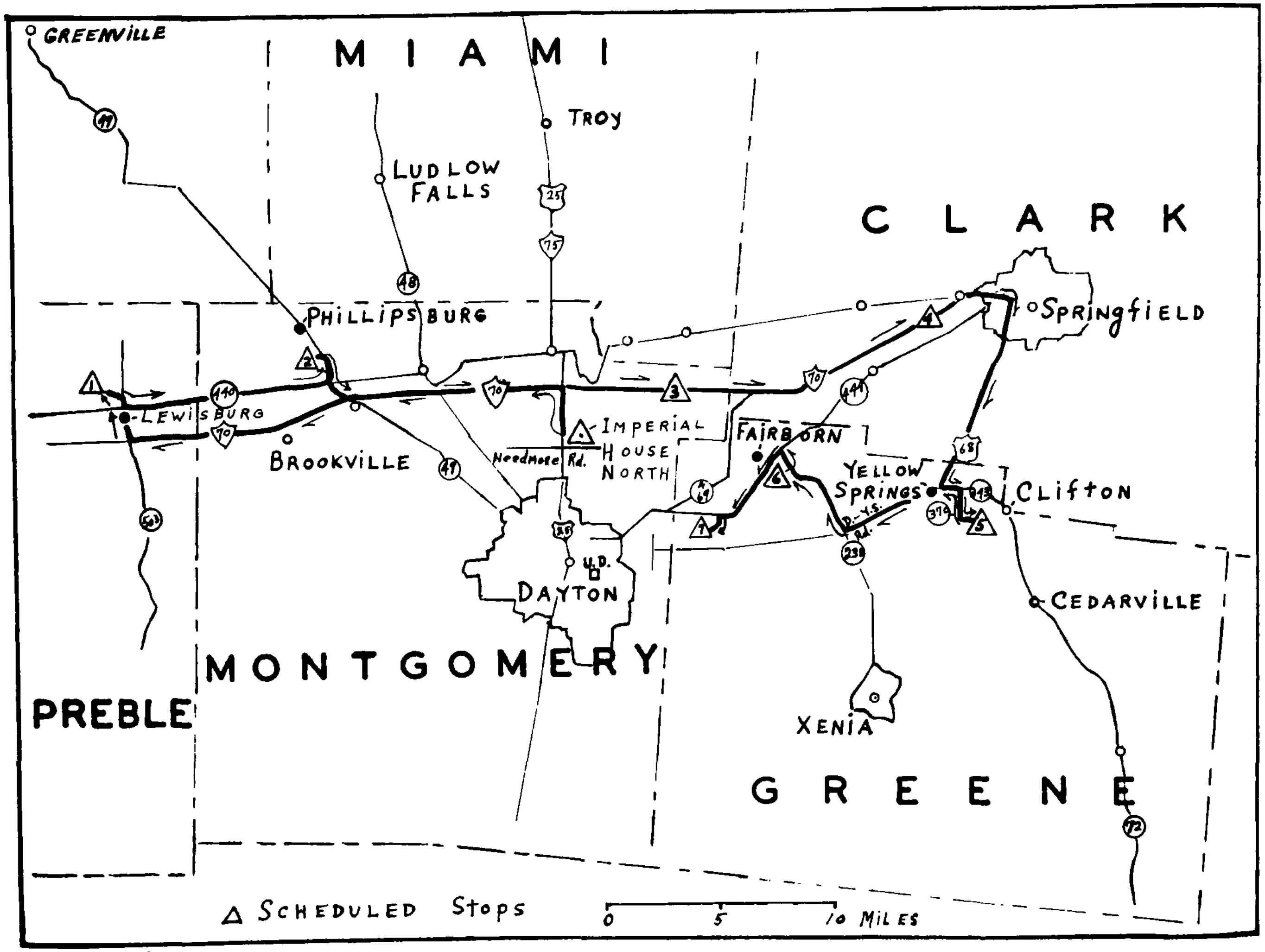
Professor Foerste acquired an interest in geology during his youth while roaming the swamp and woodland of Oakwood and the area south of Dayton. Ten years after completing his elementary education in Dayton, he graduated from Denison University at Granville with a bachelor of arts degree and 1890 was awarded the doctor of philosophy degree from Harvard. From 1890 to 1892 he studied at Heidelberg and at Paris.

As early as 1887 Doctor Foerste assisted in the U. S. Geological Survey and later was associated with the geological surveys in the states of Ohio, Indiana, and Kentucky. In 1911 and 1912 he was with the Canadian Geological Survey. For 38 years he taught physics, geology and other sciences at Steele High School in Dayton. It was mostly during the summer vacations from his teaching duties that Proffesor Foerste studied the Silurian strata of Southern Ohio and neighboring states. During his last year at Steele, Professor Foerste was offered the Chair of Paleontology at the University of Chicago but he declined because it would interrupt his researches and because such a position would be temporary due to his advanced age.

In 1931 he was named to the presidency of the Ohio Academy of Science. The latter years of his life were spent in preparing a monograph on cephalopods in cooperation with E. O. Ulrieh of the National Museum, Washington, D. C. More than any single investigator, Professor Foerste contributed to our understanding of the Silurian in this region. He was renowned as teacher and scientist. During his lifetime he gained the reputation in Europe and America as one of the leading paleontologists and geologists of the century.



Professor August Frederick Foerste (1862-1936)


GREENVILLE
MIAMI
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Needmore Rd.
FAIRBORN
YELLOW SPRINGS
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U.D.
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CEDARVILLE
MONTGOMERY
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XENIA
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△ SCHEDULED Stops
0 5 10 MILES

SILURIAN GEOLOGY OF WEST-CENTRAL OHIO

Assembly - 8:00 a.m. in parking space at north end of the parking lot at Imperial House North Motel on Interstate 75 (U. S. 25) and Needmore Road (entrance) about 4 miles north of downtown Dayton.

Itinerary - Field trip. Stops 1 through 4 - 8:00 a.m. to 12:45 p.m.

Lunch. John Bryan State Park - 12:45 p.m. to 1:30 p.m.

Field trip. Stops 5 through 7 - 1:30 p.m. to 3:30 p.m.

Box Lunches- Sign up and pay for lunches when registering or before noon on Friday, April 21. Lunches will be made available at the picnic area in John Bryan Park.

ACKNOWLEDGMENTS

The geology staff at the University of Dayton is most appreciative to Mr. Chester Brown, manager at the Lewisburg Quarry, Mr. William Karns, manager of the Laura Division of American Aggregates and Mr. W. H. Strautman, manager of the Fairborn Division of Southwestern Portland Cement Company for their gracious hospitality. We also wish to thank Bob Alberts and Gregg Klosterman, for geological information and a cross-section of Silurian strata.

ROAD LOG

Mileage

Increments	Total	
	0.0	Assembly Point - Imperial House North.

From the parking lot of the Imperial House North Motel follow the lead car back to Interstate 75 at the light. Turn right and head north on #75.

Increments	Total	
3.5	3.5	Intersection with Interstate 70. Take the turnoff to the right and follow it around onto I-70 westbound toward Richmond.
20.5	24.0	West Alexandria-Lewisburg exit from I-70. Exit to the right and turn right (north) at the first intersection onto state route 503. Continue on #503 through Lewisburg.
1.2	25.2	Junction with Route 40 (SR 440). Continue north on SR 503 for 0.5 mile and then turn left onto SR 34. Continue west on SR 34 for an additional 0.8 mile before turning left on Swishers-Mill Road.
1.3	26.5	STOP #1. Lewisburg Quarry-A division of the Marble Cliff Quarries Company, Columbus, Ohio. This quarry utilizes the Brassfield limestone for crushed stone and lime. Danger from falling rock prevents our going into the mines.

Somewhat lighter colored, even-bedded Dayton strata overlie Brassfield in quarry wall at Lewisburg.

Dayton Dolomite overlain by Osgood Shale (covered interval) and Laurel Dolomite at the Lewisburg quarry.

SILURIAN SECTION AT LEWISBURG (Modif. after Priddy, 1937, and Pennell, 1952)

Cedarville Dolomite	
Dolomite, blue-gray, weathering to gray, buff; medium-to-coarse crystalline.	15' 0"
Springfield Dolomite	
Dolomite, light-gray, weathering to buff; finely crystalline.	8' 0"
Euphemia Dolomite	
Dolomite blue-gray, mottled, weathering to gray-buff; irregularly bedded, medium-to-coarsely crystalline.	4' 6"
Laurel Dolomite	
Dolomite, grayish-blue weathers buff; hard, finely crystalline.	9' 0"
Osgood Shale	
Shale, bluish-gray, calcareous.	2' 9"
Dayton Formation	
Limestone, bluish-gray weathering to grayish-white, mottled, finely crystalline, argillaceous.	8' 0"
Brassfield Formation	
Limestone, the lower 8 feet consisting of white to tan, medium-grained, irregularly bedded strata overlain by brown to pink, coarse-grained, crinoidal, hematitic beds.	18' 9"

ROAD LOG

Mileage

Increments	Total	
	26.5	Leave Lewisburg Quarry. Backtrack by turning right onto SR 34 and proceeding to SR 503 where we take another right. Turn left at the intersection of SR 503 and SR 440 (U. S. 40) and continue eastward.
10.2	36.7	Arrive at junction of SR 440 and SR 49. Turn left onto SR 49 and head north for a little over a mile (1.3 miles). At the American Aggregates sign on the left side of the highway, turn left onto a side road and proceed a couple hundred yards to the quarry.
1.5	38.2	STOP #2. Laura Quarry located southeast of Phillipsburg. The following description is by R. K. Alberts of American Aggregates Corporation.

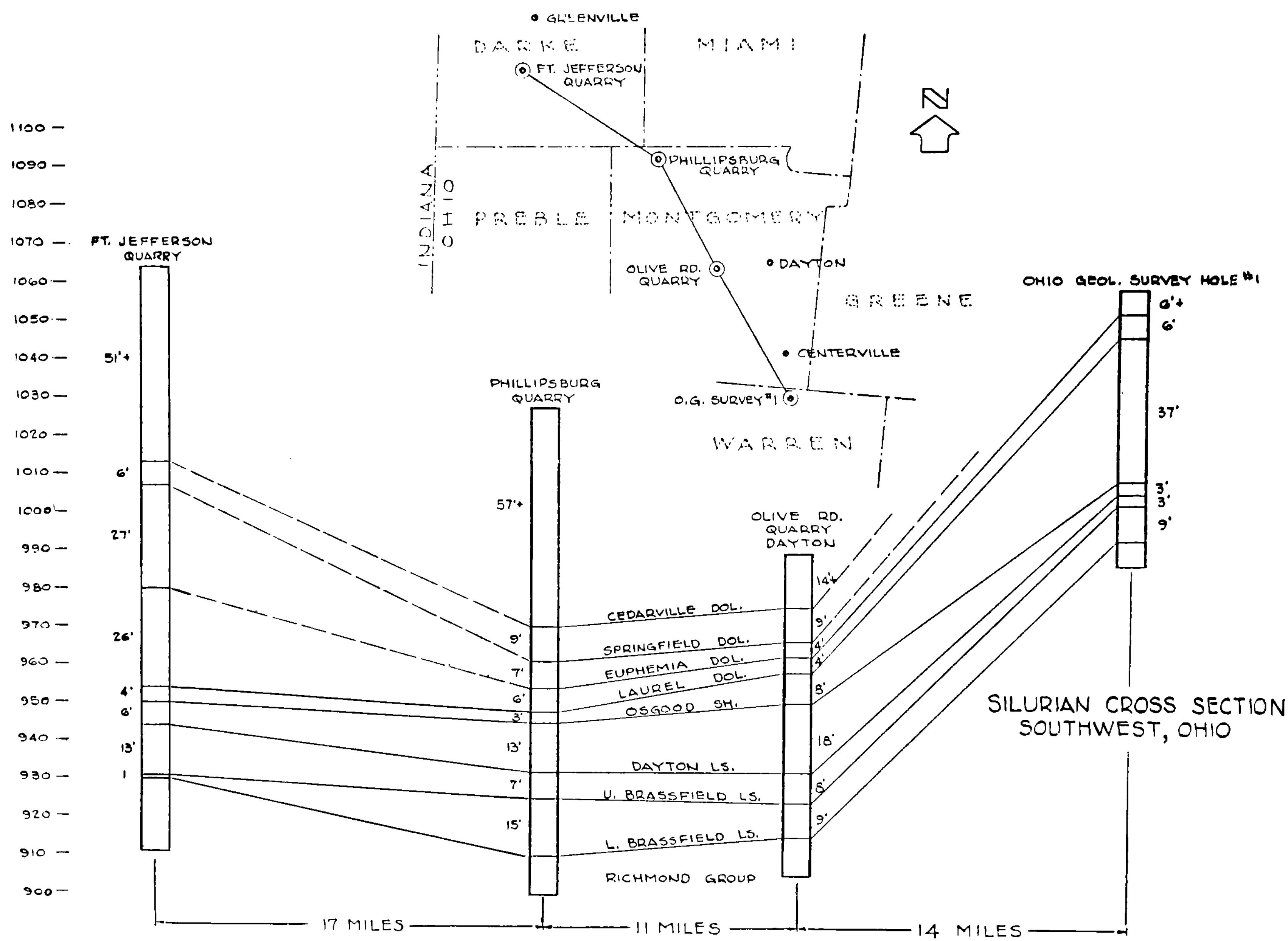
Geology of the American Aggregates Corporation -Laura Division Quarry-

Present mining at the Laura Quarry has exposed the top of the Springfield formation and 60 feet of the Cedarville. One core hole has been drilled to the top of the Ordovician and encountered 9 feet of Springfield, 7 feet of Euphemia, 6 feet of Laurel, 3 feet of Osgood, 13 feet of Dayton, and 22 feet of Brassfield. The lithologies of all these formations are similar to those found in other correlative exposures in Montgomery and surrounding counties. The attitude of the beds is very nearly horizontal but local undulations with an amplitude of several feet are present in the quarry.

The Cedarville, which is the only formation being mined at the present time, is generally a medium to coarse grained, crystalline porous dolomite but has a persistent 3 feet to 4 feet thick fine-grained siliceous dolomite bed about 35 feet above the Springfield, and a locally shaly zone about 18 feet above the Springfield. The composition of the Cedarville is very nearly that of a pure dolomite averaging 56% $CaCO_3$ and 43% $MgCO_3$.

Stone from the quarry is crushed and sized for use as construction aggregates, fluxstone, and agricultural lime.

The cross-section opposite, furnished by staff geologists of the American Aggregate Corporation, shows the thickness of all the Silurian units at the Phillipsburg quarry and adjacent areas as determined by study of cores and quarry exposures.



SILURIAN CROSS SECTION
SOUTHWEST, OHIO

ROAD LOG

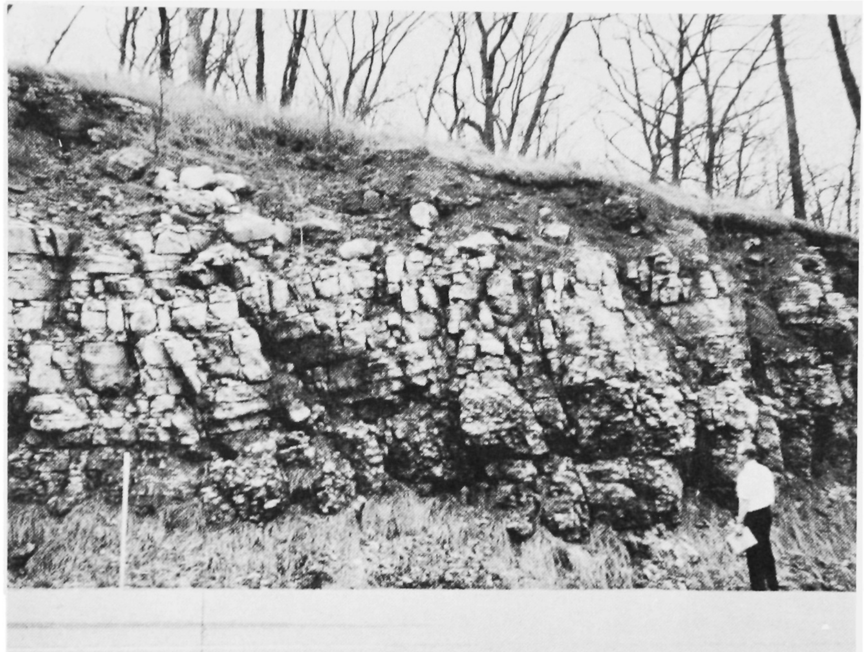
Mileage

Increments	Total	
	38.2	Leave the Laura (Phillipsburg) quarry. Go back to SR 49, turn right and proceed southward through the intersection with SR 440. You are now on SR 49 and U. S. 40. At about 1.3 miles from the preceeding intersection, U. S. 40 swings eastward and coincides with IR-70. Continue on IR-70 toward Springfield.
14.6	52.8	STOP#3. Rest Area along IR-70. Keep to right.
		Continue eastward on IR-70 until you reach the George Rogers Clark Park turn-off at SR 369. Turn off to the right and continue about 50 yards to stop sign. Turn left and go about 60 yards to parking area.
12.2	65.0	STOP #4. Highway cut along Interstate 70 near Tecumseh Road entrance.

SILURIAN SECTION ALONG IR-70, ABOUT 5 MILES WEST OF SPRINGFIELD (after Busch, '39)

Cedarville Dolomite	
Dolomite, medium-gray, medium-to-coarse grained, poorly bedded, vuggy, fossiliferous, locally brecciated.	15' +
Springfield Dolomite	
Dolomite, light-gray and tan, weathers buff, fine-grained, dense, even-bedded, silty, scattered fossils.	12' 9"
Euphemia Dolomite	
Dolomite, medium-to-light-gray, mottled, medium-grained, dense, scattered small vugs, irregularly bedded in nodular layers, fossiliferous.	10' 9"
Massie Shale	
Shale, olive-gray, interbedded with dolomite; scattered fossils.	2' ±
Covered	3' 2"
Laurel Dolomite	
Dolomite, gray to light tan, fine-to-medium-grained, dense, 2 to 4 inch beds, wavy bedding, weathers light buff, scattered fossils.	2' 4"
Osgood Shale	
Shale, olive-gray, calcareous.	2' ±

Weathered outcrop on south side of IR-70. Regularly-bedded Springfield overlies mottled, porous Euphemia Dolomite.



Brick-like Springfield beds overlain by massive, vugular Cedarville on north side of IR-70

ROAD LOG

Increments	Total	
	65.0	Return to cars. Turn right (east) onto Interstate 70 and follow route to Springfield.
5.0	70.0	Intersection IR-70 and U.S. 68. Turn right (south) onto U.S. 68 at the Pure Oil Company gas station.
10.0	80.0	Approaching Yellow Springs; turn left on SR 343 and proceed 1.1 miles to junction of SR 343 and SR 370.

ROAD LOG

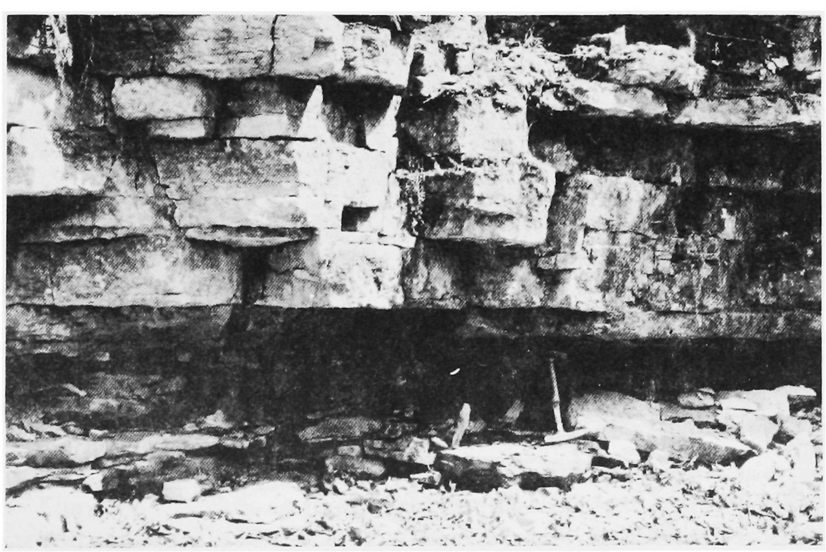
Mileage

Increments	Total	
1.1	81.1	Turn right onto SR 370 and continue 1.2 miles; turn left through entrance of John Bryan State Park.
		Bear right toward the Lower Picnic Area and Clifton Gorge Trail; the road descends (through the Silurian section) to Lower Picnic Area Parking lot.
1.9	83.0	STOP #5. Lunch stop. Box lunches will be distributed to members of the field party who signed the lunch register on the previous day. After lunch we will hike along the Little Miami River for a look at the section exposed in a side gorge upstream.

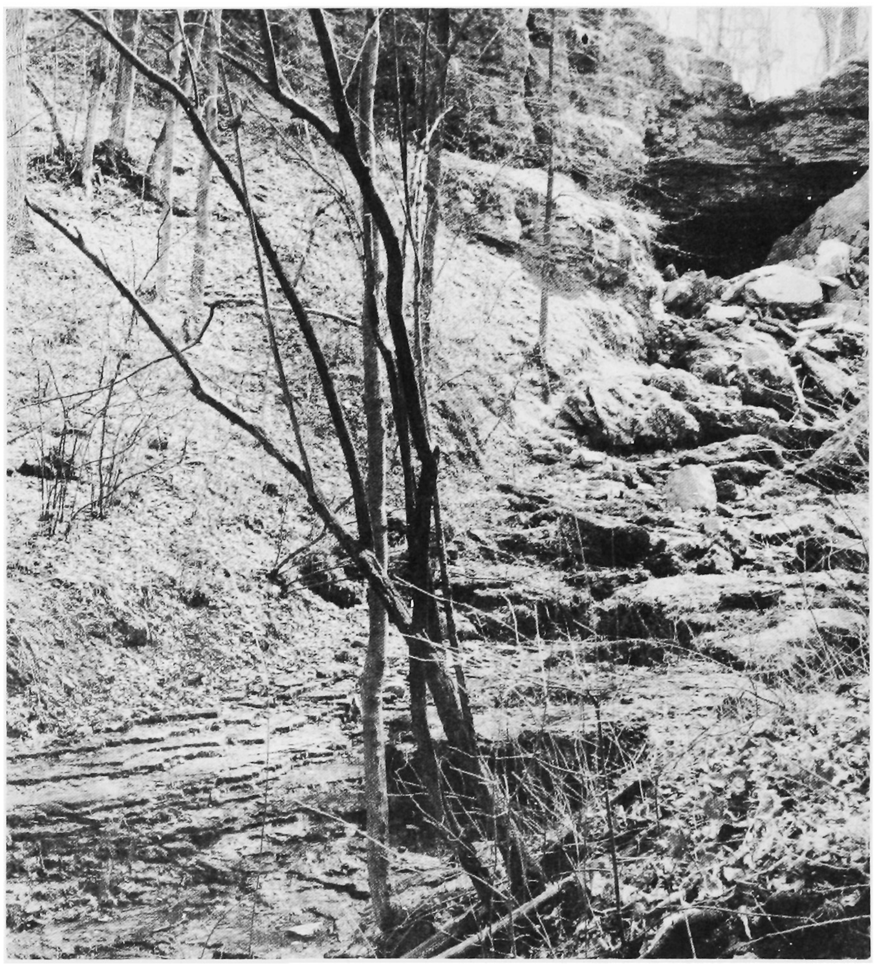
Silurian Section at John Bryan Park in Gorge 0.3 Miles Upstream of Picnic Area

Cedarville Dolomite	
Dolomite, white to blue-gray, holocrystalline, porous, small, irregular pockets or pitting, massive; cliff-former.	up to 50'
Springfield Dolomite	
Dolomite, gray, thin-bedded (brick-like appearance).	10'
Euphemia Dolomite	
Dolomite, medium-gray, mottled, medium-grained, porous and massive.	7-15'
Massive Shale	
Shale, blue-gray, calcareous, soft, some 1"-3" limestone layers in upper half.	5-6'
Laurel Dolomite	
Dolomite, buff, hard.	6-7'
Osgood Shale	
Shale, blue-gray, weathering to light brown, calcareous.	20-25'
Dayton Dolomite	
Dolomite, light-gray, fine-grained; very dense and hard.	8'
Brassfield Limestone	
Limestone, white to pink, crinoidal near top; porous and dolomitic in the lower part.	up to 50'

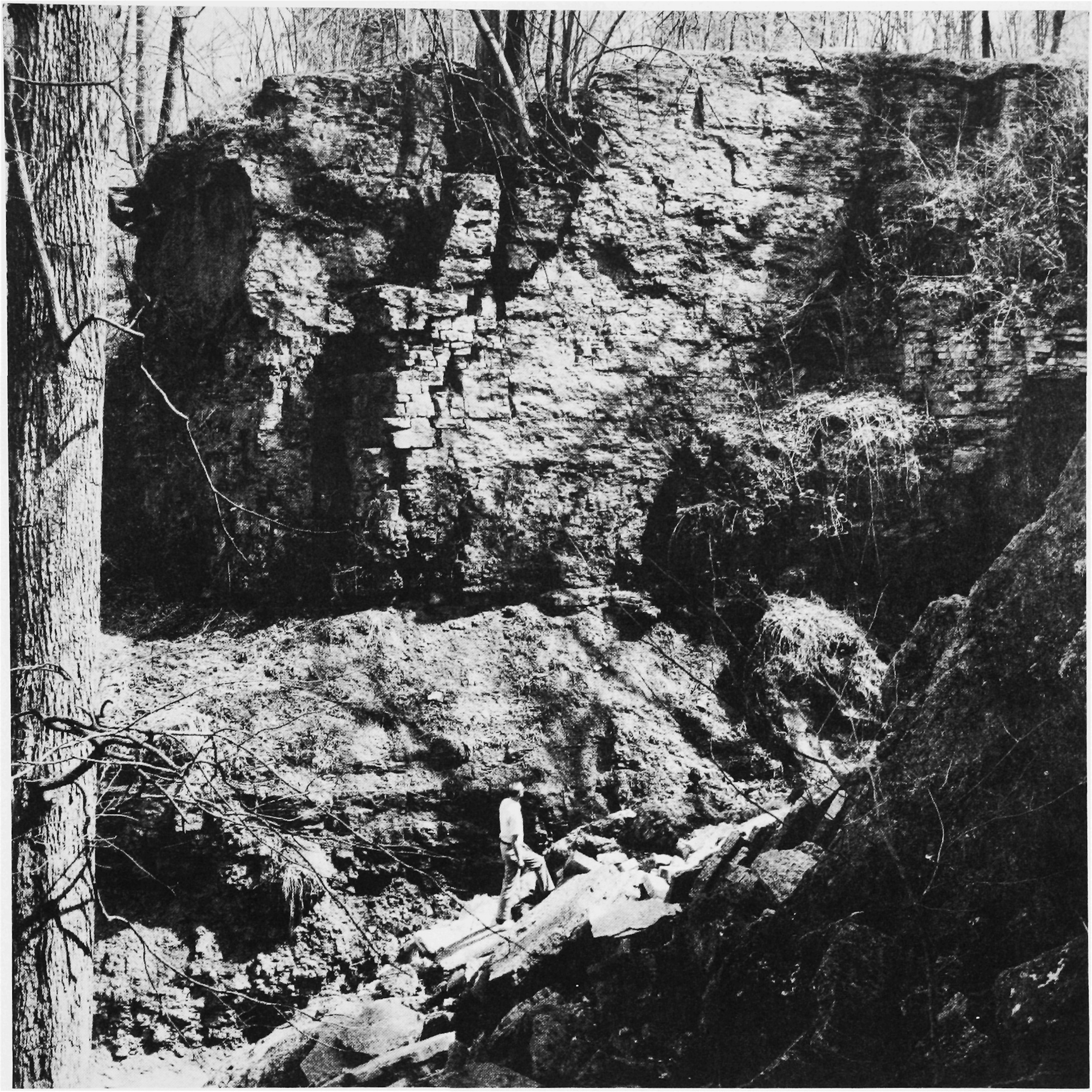
Wavy-bedded Brassfield in the lower portion of the gorge. Even-bedded Dayton can be seen upstream near top of picture.



Brassfield-Dayton contact on east side of gorge.



View of the upper portion of the gorge; the upper part of the Dayton Dolomite is in the foreground and the Osgood Shale forms the covered slope above. The cave at the top was formed by wasting of the Massie Shale and partial collapse of the Euphemia and Springfield dolomites.



Uppermost part of the gorge. The Osgood Shale underlies a ledge formed by the Laurel Dolomite. The Ledge is covered by a slope at the interval of the Massie Shale, and the steep cliff above the Massie shows the massive Euphemia, bedded Springfield, and massive Cedarville dolomites. The cave of the preceding photo can be seen at the right.

ROAD LOG

Mileage		
Increments	Total	
	83.0	Leave John Bryan State Park. Travel back to Yellow Springs, by turning right at park entrance onto SR 370 for 1.2 miles and left onto SR 343 for 1.1 miles.
2.3	85.3	Junction of SR 343 and US 68. Turn right toward Yellow Springs and proceed 0.2 miles and jog half-right onto Dayton Street. (turn-off is just before the railroad crossing on US 68). Continue southeast on Dayton Street.
4.7	90.0	Junction with SR 235. Turn right (north) toward Fairborn.
3.5	93.5	Fairborn Corporation limits. Continue 0.2 miles and turn left at entrance to Southwestern Portland Cement Company.
0.2	93.7	Stop #6. Southwestern Portland Cement Company. The management has arranged for us to visit selected areas where the Brassfield is best exposed.

SILURIAN SECTION AT SOUTHWESTERN PORTLAND CEMENT COMPANY QUARRY AT FAIRBORN, OHIO

Dayton Dolomite

7. Dolomite, tan to greenish tan, fine-grained, unfossiliferous, in thin, even beds. 5 feet plus

Brassfield Limestone

6. Crinoidal limestone, tan to pink becoming greenish in upper 2 feet, coarse-grained, locally fossiliferous, in medium beds. 8'

5. Crinoidal limestone, tan to pink, medium-to coarse-grained, interbedded with fossiliferous (corals and bryozoans) green shales--bedding wavy. 3'

4. Crinoidal limestone, reddish brown, medium-to coarse-grained, slightly shaly and argillaceous, in think wavy beds. 3'

3. Crinoidal limestone, tan, medium- to coarse-grained, sparsely fossiliferous (brachiopods, bryozoans), in medium beds. 1-2'

2. Limestone, olive brown, medium-to coarse-grained, fossiliferous (brachiopods, bryozoans), in wavy beds, disconformable at top. 1-2'

1. Limestone, pinkish, medium-to coarse-grained, coralline, in part, with numerous green shale partings--bedding thin to medium, wavy. 7'

Base not exposed (approximately 2 to 5 feet of dolomitic limestone underlies the quarry floor).

Brassfield strata exposed in the Southwestern Portland Cement Company Quarry, Fairborn, Ohio.

Economic Geology. The Fairborn area produces about 1 percent of world production of portland cement. Concrete in its simplest definition is a mass of aggregate (gravel, crushed stone, sand, etc.) held together by a hardened paste of Portland cement and water. The aggregate is essentially inert; the cement paste is the active element.

When cement is mixed with water to form a paste, the cement reacts with the water to form new minerals which adhere to each other, and to the aggregate particles. The new minerals bind the whole together and give concrete its useful properties. In order to have a cement which will have the desired characteristics, the chemical composition must be held within certain limits. The amount of allowable magnesia is limited by federal and state specifications to a maximum of 5%. The lower Brassfield limestone cannot be used for manufacture of Portland cement because its magnesium content ranges between 9 and 18 percent.

ROAD LOG

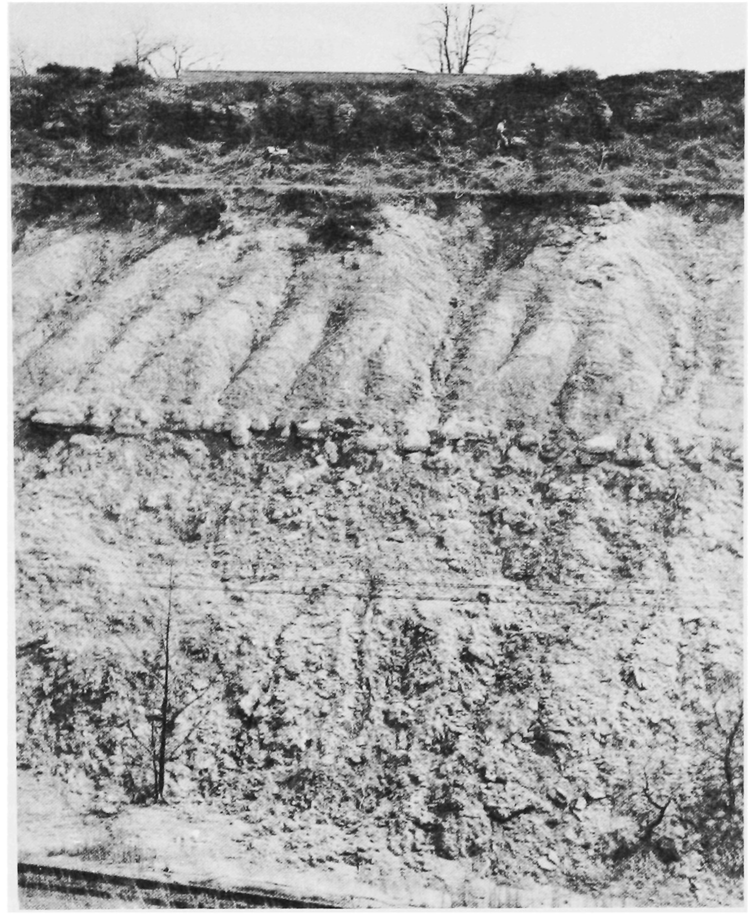
Mileage Increments	Total	
	93.7	Leave Southwestern Portland Cement Company grounds and turn left onto SR 235 and proceed 0.2 miles; turn left at intersection onto Dayton Street and take a half-right at the next intersection onto East Main Street and continue for 0.7 miles.
1.0	94.7	Junction of E. Main Street with Broad Street (SR 444). Turn left and continue on SR 444 out of Fairborn.
4.6	99.3	Keep to left lane. Turn left on Huffman Road at traffic light, travel 0.1 miles and take 2 successive right turns up hill past Wright Memorial to parking lot and rest area.
0.5	99.8	Stop 7. This is optional stop. Parking lot at Wright Memorial behind Wright Field. The bedrock immediately underlying the high-level surface of the Wright Memorial Park is Brassfield Formation. Exposed below this are the Belfast Bed or its equivalent and limestone and shale of the Richmond Group (Ordovician) extend down to the railroad tracks. This is the final stop. Returning to the highway a right turn on SR 440 will take you toward Fairborn whereas a left turn on SR 440 quickly leads to SR 4 and 69 bound toward downtown Dayton.

SILURIAN SECTION AT WRIGHT MEMORIAL ACROSS FROM HUFFMAN DAM (in part after Pennell, 1952)

Brassfield Limestone	
4. Limestone, crinoidal, pink, medium- to coarse-grained.	4' 0"
3. Limestone, buff to pink, dense, medium- to coarse-grained, fossiliferous, in irregular beds 2 to 8 inches thick.	4' 9"
2. Limestone, light gray to white, fossiliferous, porous, in irregular beds 2 inches to 1 foot thick.	9' 3"
Belfast beds (?)	
1. Silty very fine-grained dolomite and dolomitic siltstone, calcareous, light greenish-gray weathering yellowish-tan, unfossiliferous, very thinly bedded.	8' +

Ordovician Shale

Upper Ordovician and Lower Silurian strata below Wright Brothers Memorial as seen from highway SR 444. Unfossiliferous strata of possible Silurian age (Belfast bed) ? occur near the top of the denuded slope. The Brassfield forms a cliff at the top.



Thinly bedded, unfossiliferous siltstone and dolomite at the top of the denuded slope shown above.

Wavy-bedded and cross-bedded Brassfield Limestone exposed near Wright Brothers Memorial.

Brassfield Formation

Foerste (1906) gave the name Brassfield to 21 feet of limestone exposed in a railroad cut between Brassfield and Panola in Madison County, Kentucky. In 1909 he applied this name to the "Clinton limestone" of Ohio which had been mistakenly correlated by Orton in 1871 with the Clinton Limestone of New York.

The Brassfield is variable in lithology, but in the type area and in some subsurface occurrences, it consists of impure dolomite and limestone with interbeds of thin shales. Accordingly "Formation" is a more appropriate surname than the original "Limestone". Brassfield strata are generally characterized by a medium- to coarse-grained texture. In western Ohio a white to pinkish, coarse grained and massively bedded limestone unit has its thickest development in the lower half or two-thirds of outcropping beds whereas the upper part of the Brassfield may show interbedded limestone and shale. The upper Brassfield beds frequently are so rich in fossils that the result is a biostrome of corals, brachiopods and crinoid fragments. Weathering may produce a buff to reddish brown color. Very often a distinctive, lowermost member, the Belfast bed, can be observed at localities where the basal Silurian is exposed. Near Belfast, Ohio this member consists of greenish-gray silty shale interbedded with gray impure limestones. In addition to silt size quartz size grains, residues generally show the presence of glauconite.

In Adams County the thickness of the Brassfield exceeds 50 feet. Farther north its thickness decreases to approximately 30 feet in Green County and westward the Brassfield thins conspicuously from 28 feet at Ludlow Falls to about 20 feet at Lewisburg and then to 14 feet at Elkhorn Falls, 4 miles south of Richmond, Indiana. The Brassfield contact with the underlying Ordovician strata is disconformable.

Dayton Formation

Orton (1871) named strata exposed near Dayton, Ohio, the "Dayton Stone". It is typically a gray to greenish-gray fine-grained, usually dense, hard limestone at outcrops. Subsurface information indicates the Dayton strata may be either limestone or dolomite and hence the name Dayton Formation is preferred to the original name Dayton Limestone. The name was in use commercially long before Orton introduced it into the literature as a stratigraphic term. Formerly it was quarried extensively in Montgomery, Miami, and Preble counties.

In Adams and Highland counties the transition from the limestone layers of the Dayton into the overlying Estill (Alger) clays usually is abrupt. To the northwest as far as Centerville and Dayton the upper limestone beds of the Dayton become thinner, more argillaceous and interbedded with thin layers of clay which increase upward until the limestone layers are few or absent. Where limestone predominates over clay shale, this part of the section was referred to the Dayton by Foerste and where clay shale was the dominant lithology, this part of the section was called the Osgood of Ohio, although paleontological evidence favoring a correlation with the Osgood Formation of Indiana was lacking.

The formation usually ranges between 4 and 5 feet in thickness in the Dayton Area. It is over 8 feet thick at Covington in Miami County and Prosser measured 11½ feet of these beds at Ludlow Falls. At Lewisburg its thickness is 8 feet. The Dayton is not recognized at outcrops south of Andersonville, Indiana, where equivalents are considered a part of the Osgood Formation. Eastward into the basin, subsurface date show the Dayton to maintain a rather uniform thickness (5 to 15 feet) and distinctive lithology. These characteristics make it an excellent subsurface marker over several counties. The lower boundary of the Dayton with the underlying Brassfield is disconformable.

Osgood Shale

The name Osgood Shale was given by Foerste (1896) to gray shales interbedded with limestones exposed near Osgood, Ripley County, Indiana. In Ohio the Osgood consists of greenish-gray clay shale with some interbedded limestones. According to Busch (1939) the Osgood of western Ohio consists of clay shale below and shaly limestone above. An upper limestone unit (1½ feet thick) is remarkably persistent throughout west-central Ohio. The lower clay shale unit increases in thickness eastward from 2' 8" in the Eaton and Ludlow Falls regions to 18 feet 6 inches in the Springfield and Yellow Springs regions. The Osgood is 3 to 4 feet thick in the vicinity of Lewisburg and thins to 2 feet 6 inches near Laurel, Indiana. Northward from Laurel, Indiana the formation thins and disappears along an approximately east-west line through the middle of Randolph County, Indiana, and extending along the northern edge of Miami County, Ohio. Southeast of Yellow Springs the stratigraphic equivalent of the Osgood in Highland and Adams counties appears to be the Estill Shale (Alger Formation).

The lower contact of the Osgood with the Dayton in western Ohio is reported to be conformable. This relationship is now doubtful as a result of the hiatus that has been reported (Rexroad , et al. 1965) between the Estill and underlying Noland in Adams County, Ohio and in Kentucky. Conodont studies indicate Zone II of Walliser is absent.

Laural Limestone

Twelve feet of limestone exposed near Laurel, Franklin County, Indiana, were named by Foerste (1896), the Laurel Limestone. The limestone overlying the Osgood in Preble and Miami counties Ohio was correlated with the Laurel in Indiana solely on stratigraphical evidence by Foerste. Busch (1939) added paleontological evidence.

In Ohio, the Laurel consists of gray to dark gray, dense, medium-grained, even-bedded dolomitic limestone. Residues contain sizable quantities of clay, variable amounts of chert and silt, and minor amounts of pyrite and glauconite.

Foerste (1935) indicates the Laurel is 5.7 feet thick at Bryan State Park. It thickens westward to 7.2 feet at Ludlow Falls, 9 feet at Lewisburg, 25 feet at New Paris (the lower 2/3 being quite cherty), and about 50 feet near Decatur, Indiana, which is west of the type area. In Clark and Greene Counties, Ohio, the Laurel is overlain by the Euphemia Dolomite, with a contact that is described as conformable although abrupt.

Massie Shale

Foerste in 1928 used the name Massie in a field guide for strata exposed along Massie Creek near Cedarville, Ohio. Six years earlier he had referred to these shales without giving them a name. It is a gray, fossiliferous clay shale from 4 to 6 feet thick. Busch (1939) states that several layers of limestone one to three inches thick occur in the upper half. Foerste (1935) noted that the only exposure in Ohio with a fauna closely resembling that of the Waldron clay shale of Indiana occurred near Cedarville in Greene County, and Busch (1939) wrote that 13 or the 54 known species in the Massie are known elsewhere only from the Waldron of Indiana and hence correlated the two formations. Many investigators have described the contacts as conformable.

Euphemia Dolomite

Strata exposed in a quarry north of Lewisburg, Preble County, Ohio were named the Euphemia dolomite by Foerste in 1917. The Euphemia is massive, porous, and more or less mottled. This mottled appearance is due to denser and lighter colored patches of rock irregularly distributed throughout its more porous parts, the latter usually being somewhat darker. In addition to describing the mottling, Foerste (1935) indicated the Euphemia Dolomite is 7.5 thick at Cedarville, 5.5 feet thick at Ludlow Falls, 4.5 feet thick at Lewisburg, and at New Paris, Ohio, it is 2.6 feet in thickness. Residues of the Euphemia contain fine quartz silt, clay, sand-sized grains of chert, some glauconite and pyrite. Total residues are less than 3%. Although the Euphemia Dolomite has not been traced outside of Ohio nor identified south of Cedarville, it has a stratigraphic position that is partly equivalent to that of the Bisher Dolomite in Highland and Adams Counties, southern Ohio.

The Euphemia has been described as conformable on the Laurel Dolomite or, locally, the Massie Shale.

Springfield Dolomite

Orton (1973) named the rocks quarried for building stone near Springfield, Ohio, the Springfield Dolomite. In 1917, Foerste divided these strata and renamed the lower part the Euphemia Dolomite. The Springfield Formation is a light gray, generally fine-grained, thin - to medium-bedded dolomite. Residues noted by Butterman (1961) are dominated by silt, and the amount of residue appears to be notably higher than the amounts from any of the other Niagaran carbonate units with the exception of some quartz silt concentrations in the silty carbonate lithofacies of the Bisher. Although the Springfield has not been identified definitely anywhere south of Cedarville, it seems likely that it is equivalent to part of the Bisher Formation of Highland and Adams Counties.

Typical Springfield fauna, particularly *Pentamerus cf. oblongus*, were noted by Foerste (1935) to be abundant at several horizons. At the Lewisburg quarry *Pentamerus* is abundant 7 feet above the base of the Cedarville. Other geologists have suggested that typical Springfield lithology occurs at 2 different stratigraphic positions in some exposures. The contact with the underlying Euphemia is conformable.

Cedarville Dolomite

Orton (1871) proposed the name Cedarville or Guelph Limestone for a distinct lithologic unit and used the local designation of *Pentamerus* limestone because of the prolific occurrence of this brachiopod within the formation. In 1873 he designated the type locality as numerous quarried in Cedarville, Greene County, Ohio.

The fresh Cedarville rock is gray, massive, poorly bedded, porous dolomite. In some areas it bears a striking resemblance to the lower Euphemia strata. The Cedarville is a purer rock than the Euphemia, since residues are small in quantity, consisting of fine silt which increases toward the base of the formation and sand size or smaller chert fragments. Weathering breaks the massive, vuggy, fossiliferous rock down into irregular beds which in places show crossbedding.

Foerste estimated a thickness of 55 feet for that part of the Cedarville which extended from the top of the quarry west of the railroad station to the base of the Cedarville on Massie Creek half a mile farther west near Cedarville, Ohio. This evidently represents only the lower part of the total Cedarville section, since it has not been possible to discover the Cedarville in contact with any overlying Silurian formation. Foerste estimated its total thickness may exceed 100 feet and Busch (1939) later used the occurrence of *Amphicoclia costata* to piece the thickness in one quarry above the zone to the lower section in the type locality to obtain an estimate of about 95 feet. In the Moores quarry near Springfield, approximately 110 feet of Cedarville is now exposed.

According to Foerste (1935) the affinities of the Cedarville fauna are close to that of the Racine (Lockport) of southeastern Wisconsin and northeastern Illinois, many species being held in common. The lower contact with the Springfield is conformable.

LATERAL EQUIVALENTS OF SILURIAN STRATA

OF THE DAYTON AREA

The accompanying diagrammatic sketches illustrate the writers' somewhat tentative interpretation of the relationship of the Silurian strata in the Dayton area to the sections in adjacent regions. The interpretation is based largely on subsurface studies.

The Silurian rocks of the Dayton region appear to represent primarily shelf facies deposited during three distinct periods of sedimentation. The Brassfield Limestone represents the first cycle, rocks of the second comprise the Dayton, Osgood, Laurel, and Massie, and the third cycle is represented by the Durbin Group. Regional disconformities separate the strata of each cycle.

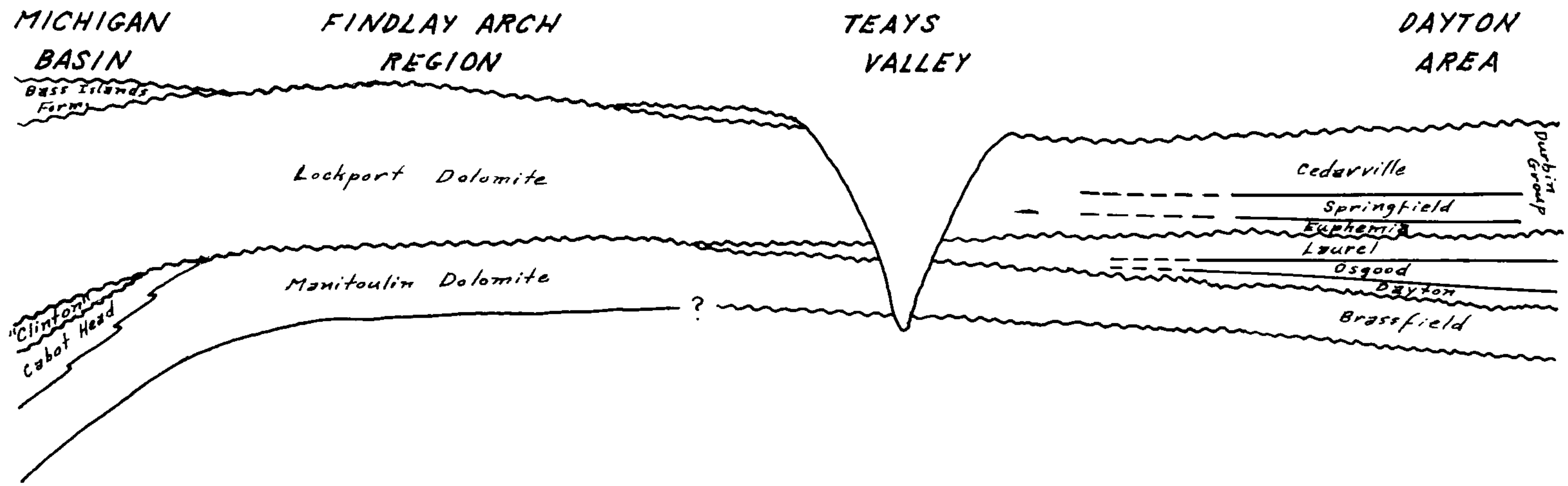
Brassfield Limestone and Equivalents

The Brassfield Limestone of this region consists of stable-shelf biostromal and bioclastic facies. Its equivalent in the Findlay Arch region to the north is the Manitoulin Dolomite, which is similar in gross aspect and was deposited in a similar tectonic environment. To the east, the Brassfield grades laterally into the Cabot Head Shale, a clay shale deposited --from an eastern source area-- in the basin area that existed in south-central Ohio. The contact between the Brassfield and the Cabot Head is interpreted as a transgressive overlap, and the same relationship exists between the Manitoulin and the Cabot Head in north-central Ohio. Fisher (1954, p. 1994) and Liberty and Bolton (1956, p. 170) have interpreted the Manitoulin-Cabot Head contact as being representative of a change from transgressive to regressive conditions, and Fisher even considers the contact to be "a near approach to a time-line". However, this interpretation neglects the fact that the Manitoulin and Brassfield represent shallow shelf facies, while the Cabot Head of the shelf flank represents a deep-water sediment, lacking in silt and containing few fossils other than fragile bryozoans, inarticulate brachiopods, and graptolites.

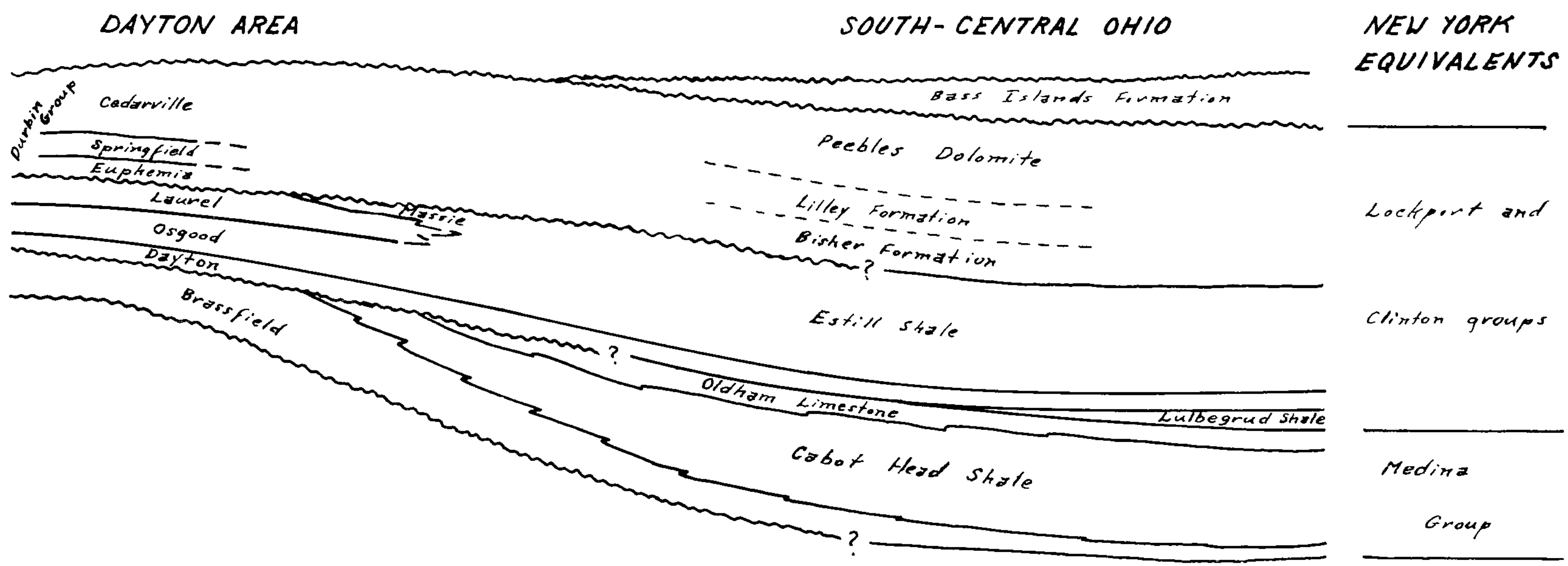
The transgressive phase of this early Silurian cycle was apparently followed by a regressive migration of the shelf carbonates out into the basin. This regressive phase is represented by the Oldham Limestone, which is restricted to the subsurface in Ohio but crops out in Kentucky above the Plum Creek Shale (Cabot Head equivalent). The Oldham, very similar in lithology to the Brassfield, occupies the same stratigraphic position as the Dyer Bay Dolomite of Ontario.

The Brassfield, Cabot Head, and Oldham can be traced into eastern Ohio, where they grade into the Medina Group. Tongues of the Medina known as "Clinton sands" in drillers' terminology actually extend into the Cabot Head in central Ohio. These Lower Silurian carbonates and clay shales of western Ohio cannot logically be assigned to the Medina, however, since the latter comprises relatively coarse terrigenous clastic rocks. The Medina Group does seem to reflect the same depositional cycle. In the Niagara Falls region the Whirlpool Sandstone at the base of the Medina and the Grimsby Sandstone at the top represent basal-transgressive and regressive equivalents of the Brassfield and Oldham, respectively, of the south-central-Ohio basin area.

In the Dayton area, and for some distance to the east, the Brassfield probably represents only the middle portion of the Brassfield-Cabot Head-Oldham sequence of the basin area in terms of time equivalence. The basal Brassfield of the shelf



MICHIGAN BASIN
FINDLAY ARCH REGION
TEAYS VALLEY
DAYTON AREA
Bass Islands Form.
Lockport Dolomite
"Clinton"
Cabot Head
Manitoulin Dolomite
?
Cedarville
Springfield
Euphemia
Laurel
Osgood
Dayton
Brassfield
Durbin Group



DAYTON AREA
SOUTH-CENTRAL OHIO
NEW YORK EQUIVALENTS
Durbin Group
Cedarville
Springfield
Euphemia
Laurel
Massie
Osgood
Dayton
Brassfield
Bass Islands Formation
Peebles Dolomite
Lilley Formation
Bisher Formation
?
Estill Shale
Oldham Limestone
Lulbegrud Shale
Cabot Head Shale
Lockport and
Clinton groups
Medina
Group

region, including discontinuous unfossiliferous basal units, may have been deposited unconformably on the underlying Ordovician long after Silurian sedimentation began in the basin area. It may also be younger than the lowest Manitoulin of the Findlay Arch region, where there is no clear evidence of Ordovician-Silurian disconformity. The upper contact of the Brassfield of the shelf region is an erosion surface which appears to truncate the Cabot Head and Oldham to the east, on the shelf flank. This erosion surface also occurs throughout the Findlay Arch region.

Dayton-Osgood-Laurel-Massie and Equivalents

The strata overlying the unconformity discussed above are not as easily traced into adjacent areas as are thos beneath it. These rocks of the second major Silurian sedimentary cycle are much more varied in terms of facies and may well contain numerous disconformities, at least in the shelf regions.

The entire sequence between the Brassfield and the Euphemia of the Dayton area can be traced northward, but the individual units lose their identity. The lateral equivalents in this direction consist mainly of silty, argillaceous dolomites, varying considerably in grain size, that become steadily thinner and eventually pinch out completely in the Findlay Arch region, where the Lockport rests directly on the Manitoulin.

To the east of the Dayton area, the Dayton Dolomite can be traced into the basin region of central Ohio. In the western part of the basin it rests in probable disconformity on the Oldham. Farther east the Dayton overlies the Lulbegrud Shale. The Lulbegrud may represent a basin-center unit deposited either in the last stages of the first Silurian sedimentary cycle or during the initial stages of the second, or between the two. In any case, the Dayton represents the initial transgressive unit of the second cycle in the shelf region.

The Osgood Shale, Laurel Limestone, and Massie Shale (which is found only to the east of Dayton) appear to be equivalent to the Estill Shale of south-central Ohio. The latter is a clay shale deposited in the deeper waters of the basin area.

These strata between the Brassfield and the Euphemia are probably equivalent to at least part of the Clinton Group of New York. The upper contact is an erosion surface which was indicated by Rittenhouse (1949) to be very widespread throughout central and western Ohio.

Durbin Group and Equivalents

The Euphemia, Springfield, and Cedarville dolomites appear to form a sequence representing the third major Silurian transgression into the shelf region of southwestern Ohio. These units are similar in gross aspect and are not separated by disconformities. Foerste (1917) combined them to form the Durbin Group.

The Durbin is easily traced northward in the subsurface. It is a resistant unit that probably forms the bedrock in most highland regions north of Dayton and Springfield at least as far as the southern edge of the buried Teays Valley. Farther north, in the Findlay Arch region, the lateral equivalent of the Durbin is the Lockport Dolomite. The Lockport of this region is considerably thicker than the Durbin, possibly indicating that the upper part of the Lockport - the "Guelph" of some workers - is missing in the area of Durbin outcrops owing to erosion. The highly arenaceous Springfield can be traced northward, but it gradually becomes less sandy and loses its identity in the Findlay Arch region. This would seem to suggest a southerly source for the terrigenous clastic material.

The tracing of the Durbin Group northward in the shelf region of western Ohio is fairly clearcut. Tracing the same unit into the basin area of south-central Ohio is not as simple, in spite of the fact that the lateral equivalents have been examined in outcrops by several workers. It does appear, however, that the Durbin corresponds generally to the Bisher, Lilley, and Peebles formations. The Bisher and Lilley differ in that they contain fossil assemblages quite distinct from those of the Durbin. In addition they include some argillaceous facies, a condition that may reflect sedimentation in the deeper waters of the basin and flanks of the shelf, as well as closer proximity to sources of terrigenous clastic material from the southeast. The Bisher may well be older, at least in part, than the basal Durbin and Lockport of the shelf areas, since the seas of the third Silurian sedimentary cycle probably did not transgress onto the shelf until considerable sedimentation had occurred in the basin regions.

The Peebles Dolomite resembles the Durbin Group in gross aspect but differs considerably in fossil content. In this respect the Peebles more closely resembles the upper part of the Lockport of the Findlay Arch region and thus may represent a unit not found in the Dayton area.

With regard to the New York section, the Durbin Group, as a rock unit, appears to be equivalent to the Lockport. The same identification cannot be made for the basinward equivalents of the Durbin, and Horvath feels that the Bisher may be at least partly a lateral equivalent of the upper portion of the Clinton Group.

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